

STUDY GUIDE

ZEOLITE SOFTENING

SUBCLASS Z

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
BUREAU OF INTEGRATED SCIENCE SERVICES
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MADISON, WI 53707

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PREFACE

This operator's study guide represents the results of an ambitious program. Operators of wastewater and water supply facilities, regulators, educators and local officials, jointly prepared the objectives and exam questions for this subgrade.

The objectives in this study guide have been organized into modules, and within each module they are grouped by major concepts.

HOW TO USE THESE OBJECTIVES WITH REFERENCES

In preparation for the exams, you should:

1. Read all the objectives that apply to the grade level desired and write down the answers to the objectives that readily come to mind.
2. Use the references at the end of the study guide to look-up answers you don't know. This one set of references covers all of the objectives.
3. Write down the answers found in the references to those objectives you could not answer from memory.
4. Review all answered objectives until you can answer each from memory.

IT IS ADVISABLE THAT YOU ATTEND SOME FORM OF FORMAL TRAINING IN THIS PROCESS BEFORE ATTEMPTING THE CERTIFICATION EXAM.

Choosing A Test Date

Before you choose a test date, consider the training opportunities available in your area. A listing of training opportunities and exam dates can be found in the annual DNR "Certified Operator," or by contacting your DNR District operator certification coordinator.

ZEOLITE SOFTENING

MODULE A: PRINCIPLE, STRUCTURE AND FUNCTION

CONCEPT: PRINCIPLE OF ZEOLITE SOFTENING

1. Define the term water hardness.
2. Explain why water becomes hard.
3. Describe the characteristics of an atom, an element, and chemical bonding.
4. Discuss the elements that cause hard water.
5. Discuss the various compounds that carry the hardness elements.
6. Explain the difference between carbonate and non-carbonate hardness.
7. Explain the difference between cations and anions.
8. Describe the basic concept involved with cation exchange softening.
9. Explain which cations are, or may be, exchanged through the ion exchange process.

CONCEPT: STRUCTURE AND FUNCTION

10. Sketch a diagram of a typical Zeolite Softening unit, and identify the components.
11. Describe the function of the media, the gravel support bed, the underdrain system, the air relief valve, and the brine distribution system.
12. Identify different types of media, citing advantages and disadvantages to each.

MODULE B: OPERATION AND MAINTENANCE

CONCEPT: OPERATION

13. Outline the problems associated with hard water, and list the advantages and disadvantages of using Zeolite Softening to control hardness.
14. Explain stable water.
15. Discuss various methods used to determine water stability.
16. Discuss problems iron poses in the Zeolite Softening process.
17. Explain the need for blending water.
18. Given a diagram of a Zeolite unit, identify the proper actions to remove the unit from service, regenerate, and return to service.
19. Explain why a Zeolite Softener needs to be regenerated.
20. Discuss methods used to determine when regeneration is necessary.
21. Describe the regeneration process.
22. Discuss the methods of disposal for wastes resulting from regeneration of ion exchange units.

CONCEPT: MAINTENANCE

23. List the maintenance items that should be performed on a daily, weekly, quarterly, semi-annual, and annual basis.

MODULE C: MONITORING AND TROUBLESHOOTING

CONCEPT: MONITORING

24. List the units of measurement and conversion factors associated with water hardness.
25. Identify the appropriate values for hard and soft water.
26. Identify the laboratory tests used for process control in Zeolite Softening, and discuss how often each test should run.
27. Briefly summarize the EDTA Titration method of testing hardness, and list the tests necessary for Langelier Index determination.
28. Describe the purpose of a hydrometer in Zeolite Softening.

CONCEPT: TROUBLESHOOTING

29. Indicate the possible cause(s) and solution for the depth of media increasing in a Zeolite Softener.
30. Indicate the possible cause(s) and solution for the depth of media decreasing in a Zeolite Softener.
31. Indicate the possible cause(s) and solution for finished water having a salty taste after regeneration of a Zeolite Softener.
32. Indicate the possible cause(s) and solution for a loss of softening capacity in a Zeolite Softener.
33. Indicate the possible cause(s) and solution for erratic softening capacity in a Zeolite Softener.
34. Indicate the possible cause(s) and solution for corrosion in a Zeolite Softener.
35. Indicate the possible cause(s) and solution for finished water being too hard in a Zeolite Softener.

MODULE D: SAFETY AND CALCULATIONS

CONCEPT: SAFETY

36. Describe the safety factors to consider in the Zeolite Softening process.

CONCEPT: CALCULATIONS

37. Given the necessary data, calculate water hardness.
38. Given the necessary data, calculate pounds of salt needed to remove hardness or to regenerate a Zeolite Softening unit.
39. Given the necessary data, calculate the exchange capacity of a Zeolite Softening unit.

RESOURCES

1. SMALL WATER SYSTEM OPERATION AND MAINTENANCE. 1st Edition (1990). Kenneth D. Kerri. California State University, 6000 J Street, Sacramento, CA 95819-6025. Phone (916) 278-6142.
2. STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER. 17th Edition (1989), 18th Edition (1992). Joint Publication of: American Public Health Association; American Water Works Association; and, Water Environment Federation (Old WPCF). Publication Office: American Public Health Association, 1015 Fifteenth Street NW, Washington, DC 20005.
3. WATER TREATMENT PLANT OPERATION. 2nd Edition (1989). Volumes 1 and 2. Kenneth D. Kerri. California State University, 6000 J Street, Sacramento, CA 95819-6025. Phone (916) 278-6142.
4. WISCONSIN ADMINISTRATIVE CODE NR 809 (OLD 109) SAFE DRINKING WATER. Wisconsin Department of Natural Resources, Attn: Ken Cramer, P.O. Box 7921, Madison WI 53707.
5. WISCONSIN ADMINISTRATIVE CODE NR 811 REQUIREMENTS FOR THE OPERATION AND DESIGN OF COMMUNITY WATER SYSTEMS. Wisconsin Department of Natural Resources, Attn: Ken Cramer, P.O. Box 7921, Madison, WI 53707.

THE FOLLOWING ADDITIONAL RESOURCES CAN BE OBTAINED FROM:

AMERICAN WATER WORKS ASSOCIATION
MEMBER SERVICE DEPARTMENT
6666 W. QUINCY AVENUE
DENVER, CO 80235
(303) 794-7711

1-800-92-ORDER (CHARGE CARD CUSTOMERS OR AWWA MEMBERS ONLY)

6. BASIC MANAGEMENT PRINCIPLES FOR SMALL WATER SYSTEMS. AWWA No. 20222 (1982). VOLUME II, AWWA No. 20225 (1984).
7. CORROSION CONTROL FOR OPERATORS. AWWA No. 20232 (1986).
8. CROSS-CONNECTION AND BACKFLOW PREVENTION. Gustave J. Angele. AWWA No. 20106 (1974).
9. DISINFECTION BY-PRODUCTS: CURRENT PERSPECTIVES. AWWA No. 20032 (1989).

10. MAINTENANCE MANAGEMENT. James K. Jordan. AWWA No. 20252 (1990).
11. NEW DIMENSIONS IN SAFE DRINKING WATER-SECOND EDITION. AWWA No. 20235 (1988).
12. PLAIN TALK ABOUT DRINKING WATER. James M. Symons. AWWA No. 70076 (1991).
13. PUBLIC INFORMATION - HOW TO BUILD A SUCCESSFUL PUBLIC INFORMATION/PUBLIC RELATIONS PROGRAM. AWWA No. 20242 (1989).
14. SAFE DRINKING WATER ACT SERIES:
 - SURFACE WATER TREATMENT RULE. AWWA No. 70055 (1990)
 - PUBLIC NOTIFICATION. AWWA No. 70056 (1990)
 - TOTAL COLIFORM RULE. AWWA No. 70057 (1990)
 - VOC'S AND UNREGULATED CONTAMINANTS. AWWA No. 70058 (1990)
 - LEAD AND COPPER. AWWA No. 70073 (1991)
 - PHASE II: VOC'S, IOC'S, AND SOC'S. AWWA No. 70074 (1991)
15. TREATMENT TECHNIQUES FOR CONTROLLING TRIHALOMETHANE IN DRINKING WATER. AWWA, No. 20221 (1982).
16. WATER CONSERVATION. William O. Maddaus. AWWA No. 20238 (1987)
17. WATER QUALITY AND TREATMENT-FOURTH EDITION. AWWA No. 10053 (1990).